Weekly Updates – Vinayak Gajendra Panchal

I designed 2 scenarios in SUMO for the Ablation studies, based on (30%, and 50% not following rules i.e. these vehicles will have parameters changed).

Scenario 1: Junction with priority 1-lane 4-way intersection. [changing one parameter at a time]

Scenario 2: Junction with priority 1 lane 4-way intersection. [keeping one parameter constant and checking the trend]

Details of these scenarios are discussed in detail below.

Simulation setup (All scenarios):

Step-length	0.10 sec (10 cycles/sec)
Collision.action	remove
Collision.stoptime	0 sec
Collision.check-junctions	True
'- - log' (simulation log files)	simulation_main.log
Number of Vehicles	500

Scenario 1: Junction with priority (default right-of-way) 1-lane 4-way intersection [changing one parameter at a time]

The scenario is subdivided into multiple cases where ablation studies were conducted.

Junction setting: junction type is priority and right-of-way is the default.

Case 1: 30% of the vehicles have modified parameters (ego vehicle), while the remaining 70% have their default settings.

Experiment setup: 30% of ego vehicles (ego_veh) were distributed at each corner edge of the road. All flow vehicles have different end times introducing some randomness.

```
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    <route id="r_1" edges="E2 E1" />
    <route id="r_2" edges="-E3 -E2" />
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    <flow id="f_5" begin="0.00" route="r_3" end="500.00" number="87" />
    <flow id="f_6" begin="0.00" route="r_2" end="1200.00" number="87" />
    <flow id="f_7" begin="0.00" route="r_1" end="1500.00" number="88" />
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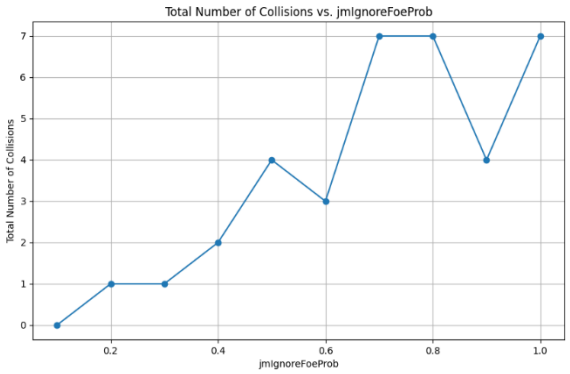
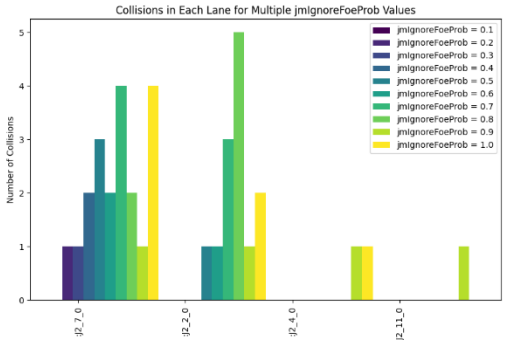
Parameters for the ablation studies:

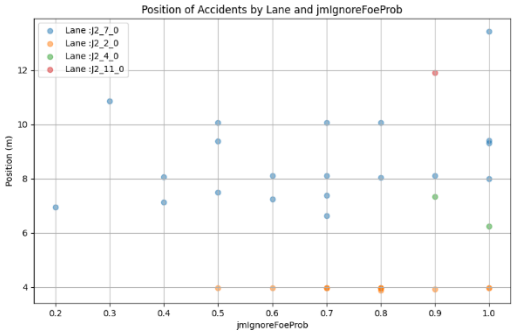
Parameter	Range/value	Reason
jmIgnoreFoeProb	[0.1,1.0] at step of 0.1	Probability at which it will ignore foe vehicle.

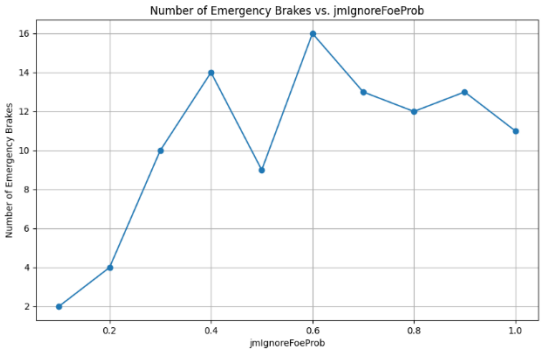
jmIgnoreFoeSpeed	20 m/s	Goes with the jmIgnoreFoeProb parameter. Will ignore speeds of foe vehicle bellow 20 m/s
tau	[0.01,0.1] at step of 0.01	Desired time headway
accel	[0.5,1,2,3,4,5,7,9,10,20,50]	Acceleration of vehicles
decel	[0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0]	Deceleration of vehicles
sigmaerror	[0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0]	Driving error magnitude

jmIgnoreFoeProb: Increasing the likelihood of the ego vehicle ignoring enemy vehicles leads to more collisions at intersections and more instances of the ego vehicle having to brake suddenly. The most collisions, a total of 7, happened when the probability of ignoring enemy vehicles was set at 0.7, 0.8, and 1.0. When the parameter jmIgnoreFoeSpeed is set at 20 meters per second, the ego vehicle begins to disregard enemy vehicles traveling at speeds below 20 meters per second, resulting in more collisions at intersections. The highest number of collisions occurred at specific intersection positions, J2_7_0 and J2_2_0, as shown by collision data in different lanes at various jmIgnoreFoeProb values.

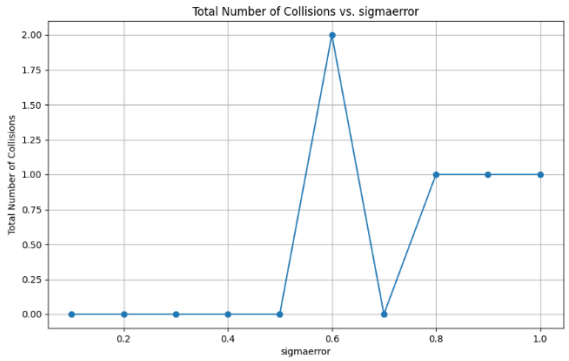


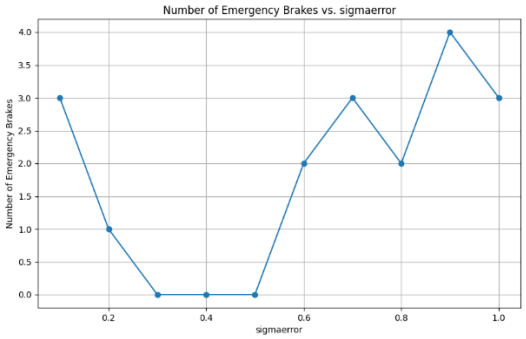


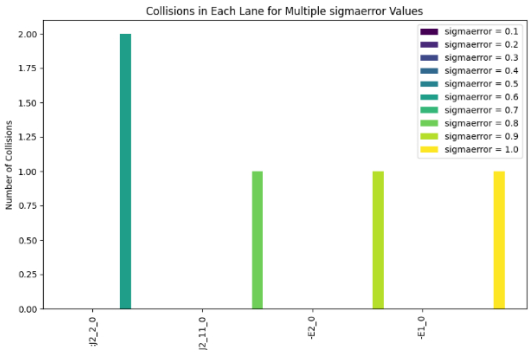


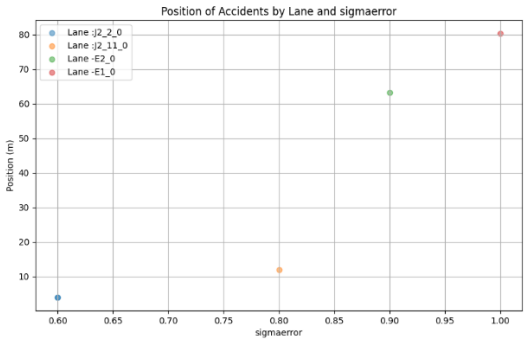


Sigma error: Increasing the sigma error values results in the number of collisions at the junction remaining at zero until it reaches 0.5 and peaks at 0.6 with 2 collisions. Afterward, there is a noticeable upward trend in collision occurrences. Additionally, there is an observed increase in emergency braking events by the vehicle as the values of sigma error are raised. Following the adjustment of sigma error values, there were two collisions at junctions and two rear-end edge collisions documented as a direct outcome of these parameter changes.

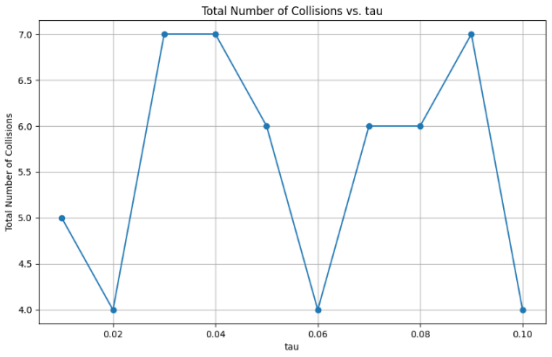


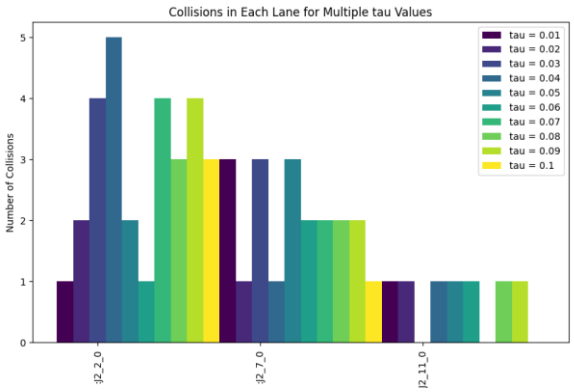


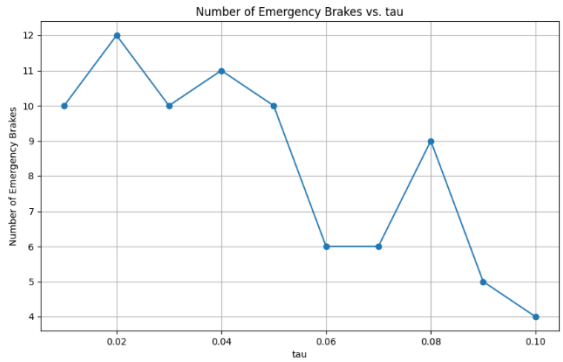


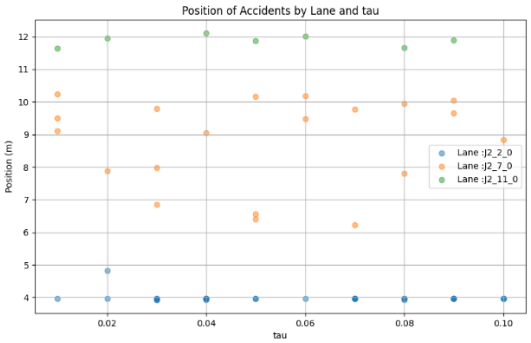


Tau: As the tau values increase, the number of collisions at junctions shows a fluctuating pattern, while the incidents of emergency braking by the vehicle decrease. The peak occurred at tau values of 0.04, 0.05, and 0.09, resulting in 7 collisions. The collision data for each lane at various tau values clearly indicates that the highest number of collisions occurred at the junction positions J2_2_0 and J2_7_0.

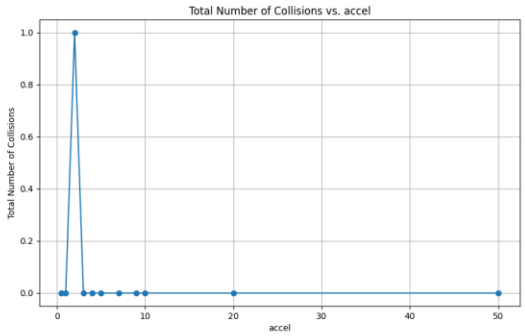


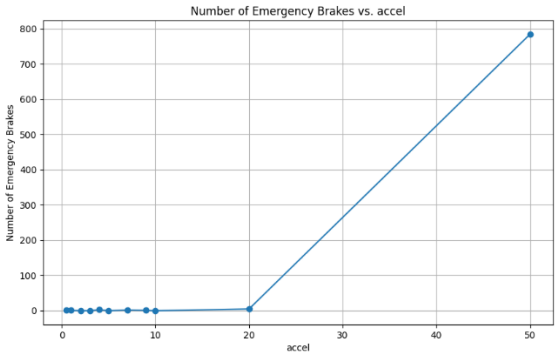


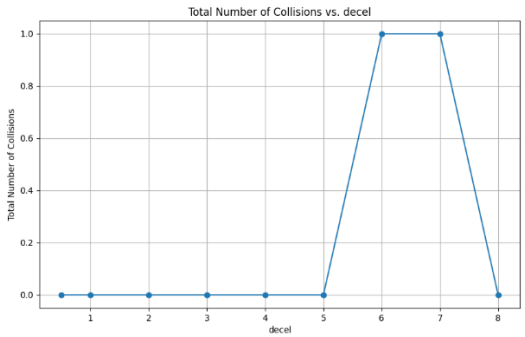


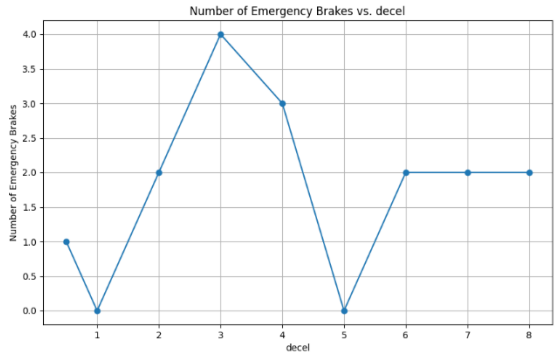


Accel & Decel: Increasing vehicle acceleration resulted in just one collision at 2 m/s^2. However, when the acceleration reached 50 m/s^2, there were about 800 instances of emergency braking. At deceleration levels of 6 and 7 m/s^2, only one collision was recorded. Moreover, the number of emergency braking occurrences exhibited variability as deceleration increased.









Case 2: 50% of the vehicles have modified parameters (ego vehicle), while the remaining 50% have their default settings.

Experiment setup: 50% of each kind of vehicle was distributed at each corner edge of the road. All flow vehicles have different end times introducing some randomness.

```
    <route id="r_0" edges="-E1 -E0" />
    <route id="r_1" edges="E2 E1" />
    <route id="r_2" edges="-E3 -E2" />
    <route id="r_3" edges="E0 -E2" />

    <flow id="f_0" type="ego_veh" begin="0.00" route="r_0" end="200.00" number="62" />
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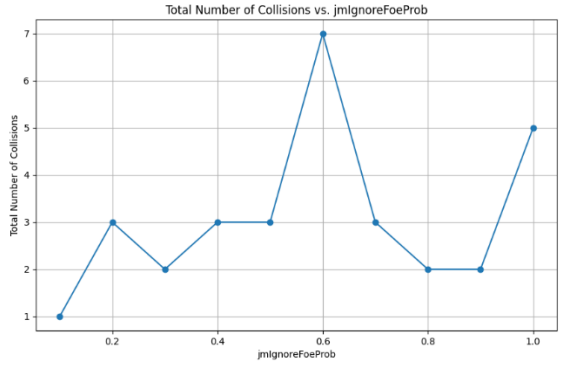
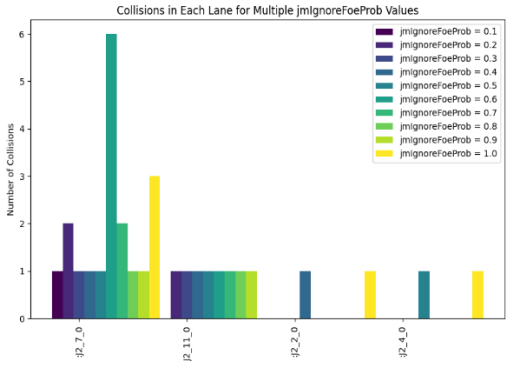
</routes>
```

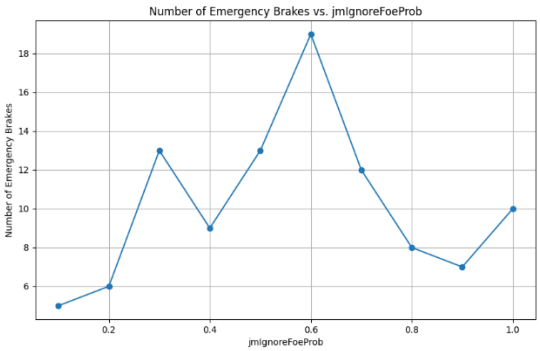
Parameters for the ablation studies:

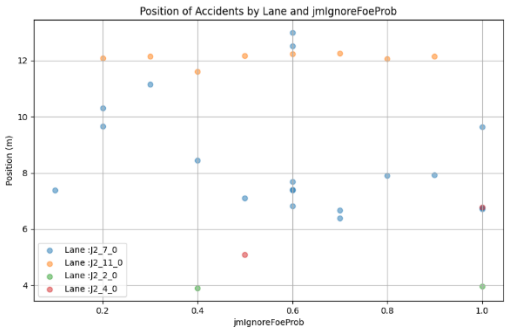
Parameter	Range/value	Reason
jmIgnoreFoeProb	[0.1,1.0] at step of 0.1	Probability at which it will ignore foe vehicle.
jmIgnoreFoeSpeed	20 m/s	Goes with the jmIgnoreFoeProb parameter. Will ignore speeds of foe vehicle bellow 20 m/s
tau	[0.01,0.1] at step of 0.01	Desired time headway
accel	[0.5,1,2,3,4,5,7,9,10,20,50]	Acceleration of vehicle
sigmaerror	[0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0]	Driving error magnitude

jmIgnoreFoeProb: Increasing the probability of ignoring foe vehicles results in a rise in the number of collisions at junctions and instances of emergency braking by the ego vehicle. This increase continues until it reaches its peak at a probability value of 0.6. When the parameter jmIgnoreFoeSpeed is set at 20 m/s, the ego vehicle starts to disregard foe vehicles traveling at speeds below 20 m/s, which, in turn, leads to a higher frequency of collisions at junctions. The highest number of collisions occurs at junction position J2_7_0, as indicated by the collision data in different lanes at varying jmIgnoreFoeProb values.

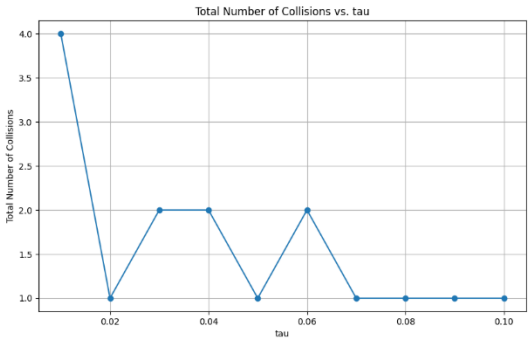


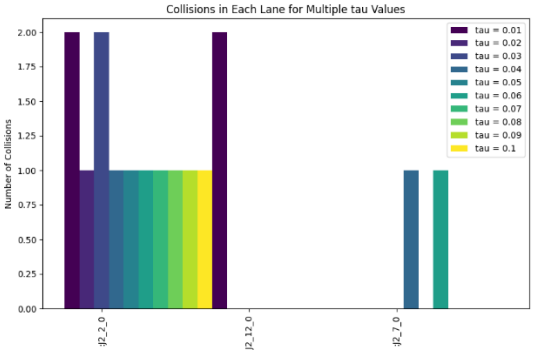


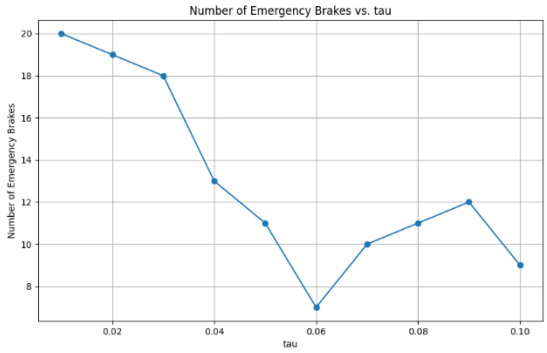


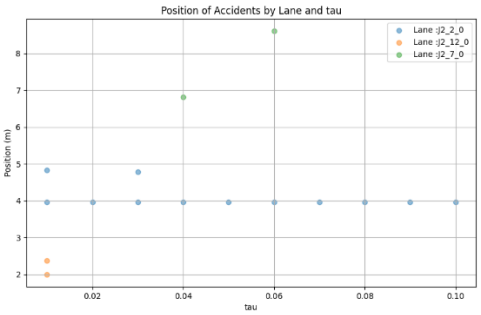


Tau: One increasing the tau values the number of collisions at junction decreases and emergency brakes by vehicle decreases.It peaked at 0.01 with 4 collisions. It is evident from the Collisions in each lane at different tau that the maximum number of collisions happened at the J_2_2_0 junction position.

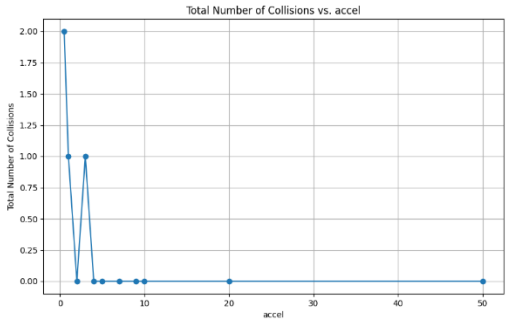


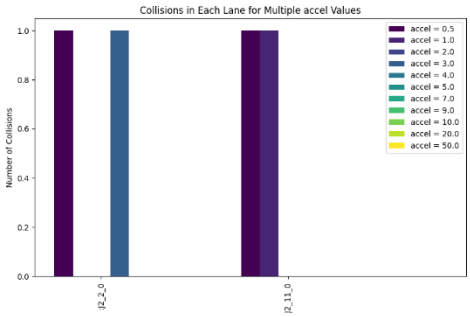


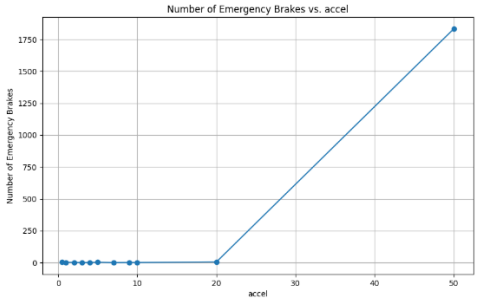


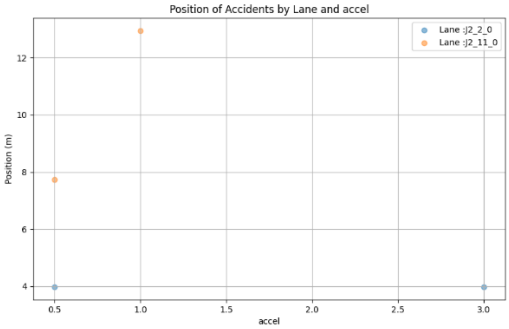


accel: One increasing the acceleration values of vehicles the number of collisions at junction decreases and emergency brakes by vehicle increases. When vehicles accelerate more rapidly, they are likely to clear intersections more quickly, reducing the potential for collisions. This is because faster acceleration allows vehicles to traverse the junction and enter the flow of traffic before other vehicles from perpendicular directions.

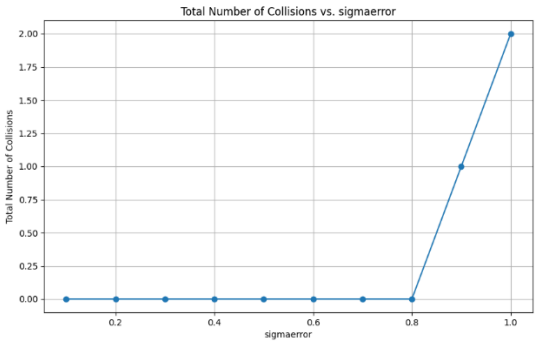


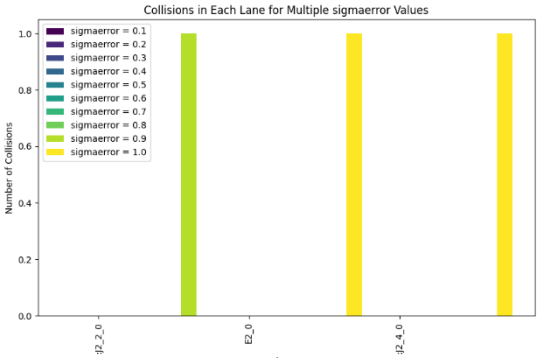


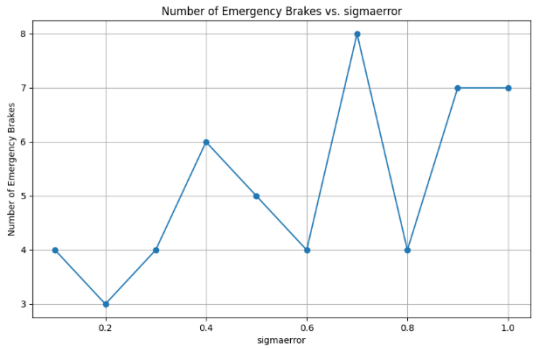


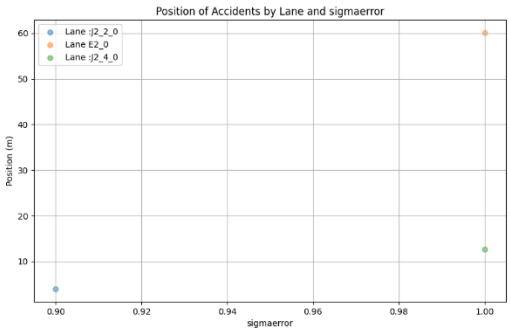


Sigma error: Increasing the sigma error values results in the number of collisions at the junction remaining at zero until it reaches 0.8. Afterward, there is a noticeable upward trend in collision occurrences. Additionally, there is an observed increase in emergency braking events by the vehicle as the values of sigma error are raised. Following the adjustment of sigma error values, there were two collisions at junctions and one rear-end collision documented as a direct outcome of these parameter changes.





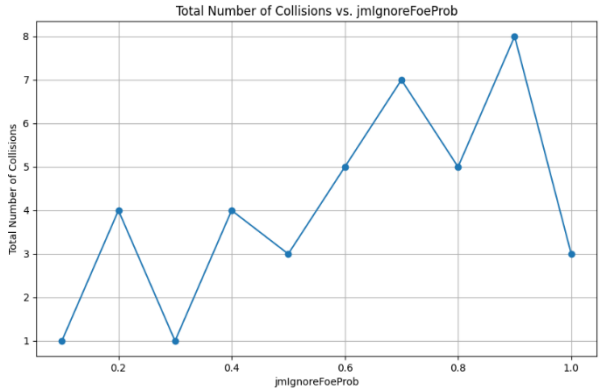


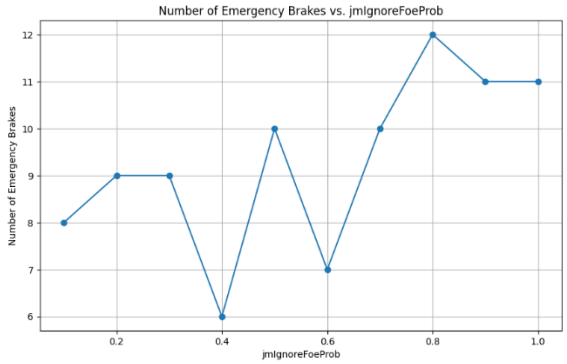


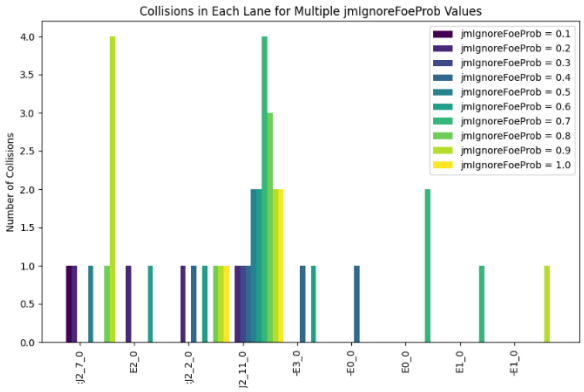
Scenario 2: Junction with priority 1 lane 4-way intersection. [keeping one parameter constant and checking the trend]

Case: 50% of the vehicles, specifically the ego vehicles, have customized parameters, while the other half retains their default settings, and these custom parameters include sigmaerror at 0.9, with variations in the jmIgnoreFoeProb probability values.

When the driver error magnitude (sigma error) is set to 0.9, and the "ignore foe" probability is varied, a compelling pattern emerges in the simulation. Notably, there is a pronounced increase in both the number of collisions and instances of emergency braking among simulated vehicles. The maximum number of collisions happen at 0.9 probability value with 8 collisions and 11 emergency brakes. Moreover, as "jmIgnoreFoeProb" increases, a consistent upward trend is observed in both collision and emergency braking events. What makes this observation even more significant is that these incidents are not confined to junctions but also extend to edge lanes.

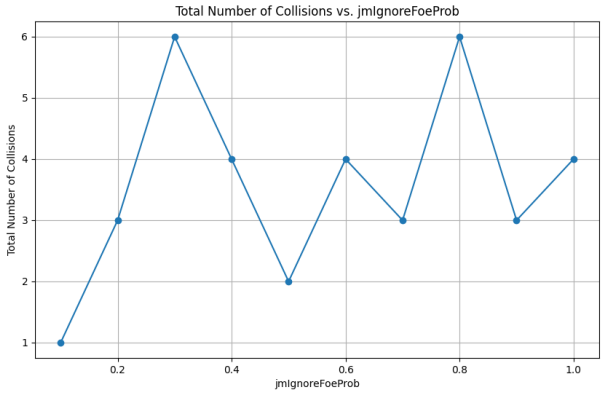


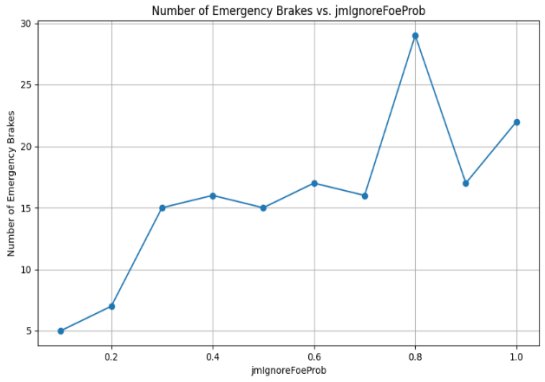


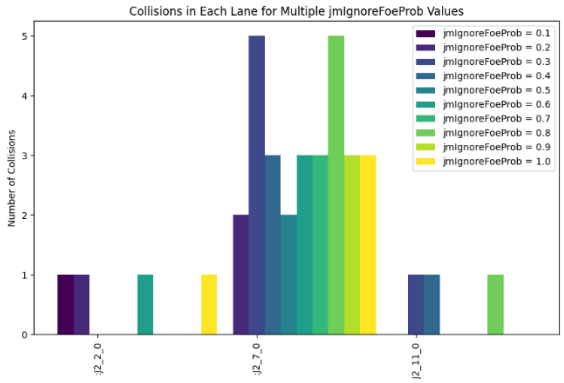


Case: 50% of the vehicles, specifically the ego vehicles, have customized parameters, while the other half retains their default settings, and these custom parameters include decel at 6 m/s^2, with variations in the jmIgnoreFoeProb probability values.

This configuration also resulted in a noticeable rise in junction-related collisions and incidents of emergency braking. The highest count of collisions, amounting to 6, and a substantial 28 cases of emergency brakes occur when the "ignore foe" probability is set to 0.8. Additionally, there is a consistent upward trend in both collision frequency and emergency braking occurrences as "jmIgnoreFoeProb" increases, emphasizing the correlation between this parameter and the prevalence of such traffic incidents.



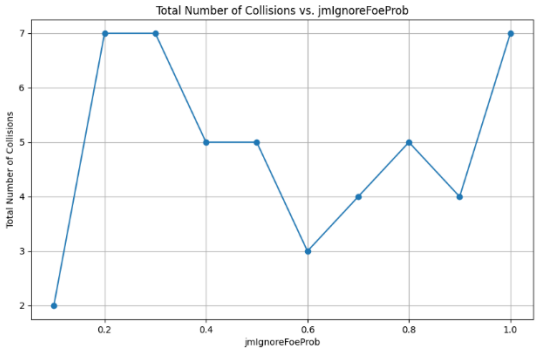


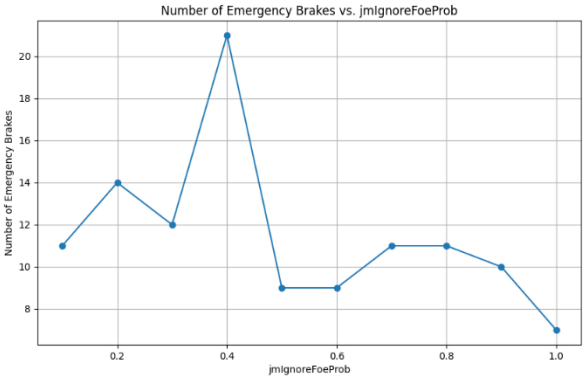


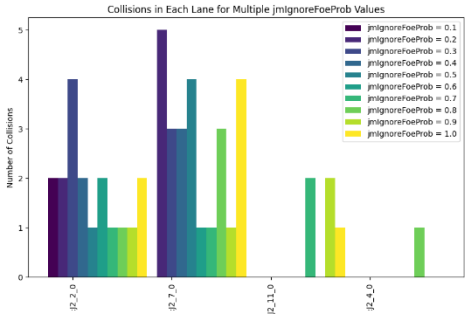
Case: 50% of the vehicles, specifically the ego vehicles, have customized parameters, while the other half retain their default settings, and these custom parameters include tau at 0.04, with variations in the jmIgno

In this scenario, we observed a noticeable increase in junction-related collisions and instances of emergency braking. The most significant collision count, totaling 7, was observed when the "ignore foe" probability was set to 0.2, 0.3, and 1.0. Additionally, an interesting trend emerged as "jmIgnoreFoeProb" varied. There was a consistent upward trend in the frequency of collisions, indicating a correlation between this parameter and the occurrence of traffic collisions. However, there was a decreasing trend in the number of emergency

braking events. This result suggests that, with customized parameters, the behavior of ego vehicles is more prone to collision incidents at junctionsreFoeProb probability values.







Challenges Encountered: The main problem we faced was that traffic-type situations frequently happened at the junction. This was because vehicles had the right of way most of the time, leading to fewer collisions at the junction. To fix this, we can use a different strategy for distributing vehicle types or make sure we know exactly when flow vehicles finish their routes. This problem usually occurs in small junctions with just one lane and no traffic lights.